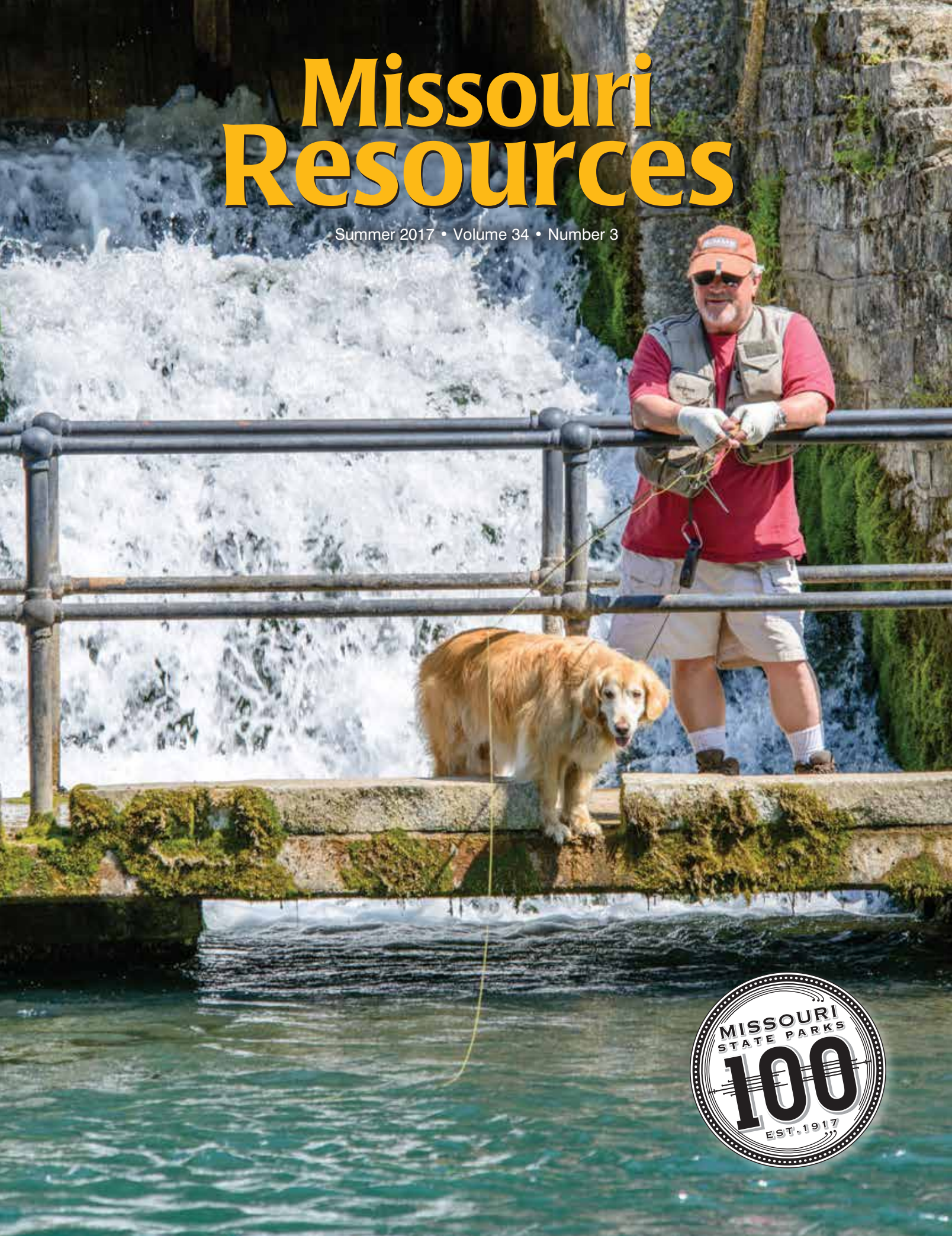


Missouri Resources

Summer 2017 • Volume 34 • Number 3



director's comment

This is my first summer in Missouri, and I am already enjoying the great opportunities our state offers to be outdoors in the warm weather and sunshine.

This year, Missouri State Parks is celebrating 100 years of serving Missouri residents and visitors. Established on April 9, 1917, the park system has grown to more than 150,000 acres that preserve the state's finest landscapes and landmarks. These areas provide a variety of opportunities to hike, camp, fish, discover the past and explore nature.

An excellent way to experience the state park system is with a Centennial Passport. Just pick up a passport (you can do a printed or electronic passport) and visit any or all of the 88 state parks and historic sites listed in the passport. Those who complete the program by Oct. 31, 2017, will be eligible to receive special Missouri State Parks backpacks, merchandise and vacation packages. I hope to see you out there this summer exploring new parks or revisiting old favorites and discovering something new!

Also this summer, on Aug. 21, the total eclipse of the sun will be visible in a large portion of Missouri. The last time a total eclipse was visible in Missouri was Aug. 7, 1869. There are 42 locations in the state park system



where you can see the total eclipse. Parks and sites will host a variety of events, including a special Katy Trail bike ride and interpretive programs on how to view the eclipse safely, how the eclipse affected history and even to test if pines whisper during an eclipse. For information, visit mostateparks.com.

Speaking of visiting us online, we are moving our Missouri Resources magazine online this fall. The Summer 2017 issue is the last issue we will print and mail.

We are updating the magazine's look and feel, and future issues will be

available online at dnr.mo.gov.

Thank you for your interest in Missouri Resources. We appreciate your support of our natural resources and hope you continue to enjoy our information online at dnr.mo.gov.

I also hope you will follow us on Twitter @MoDNR and soon on Facebook.

Carol S. Comer
Director, Missouri Department of Natural Resources

Missouri Resources

Summer 2017
Volume 34 • Number 3

Governor of Missouri **Eric R. Greitens**

Department Director **Carol S. Comer**

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Acting Director, Division of Administrative Support **Janet P. Mertens**

Director, Division of Environmental Quality **Ed Galbraith**

Director, Missouri State Parks **Ben Ellis**

Director, Missouri Geological Survey **Joe Gillman**

Director, Environmental Improvement and Energy Resources Authority **Karen Massey**

Mission Statement

The mission of the Missouri Department of Natural Resources is to protect our air, land and water; to preserve our unique natural and historic places; and to provide recreational and learning opportunities for everyone.

Editor
Stuart Westmoreland

Design Director
Belinda Hughes

Photographers
Ben Nickelson
Andrew Richmond

Assistant Editor
Andrew Richmond

Circulation
Publications staff

Editorial Board
Andrea Balkenbush
Hylan Beydler
Renee Bungart
Stuart Westmoreland

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2 Paddler's Perspective

by Rob Hunt

One hundred miles down the Missouri River by kayak or canoe – Paddle MO 2016. The enthusiasm and success of the inaugural journey will be relived this year, visiting new towns, new camps, and offering more natural resource experiences. Sign up today!

8 Make Plans for Your Spot in the Sun

by Tom Uhlenbrock

This summer's total eclipse of the sun will be a once-in-a-lifetime occurrence. Missouri State Parks will host events that explain why this celestial event is occurring and how to experience it safely. Don't miss this amazing two-and-a-half minutes.

14 Stream Piracy

by Jeffrey Crews

What is stream piracy and why should I care? These hydrological short circuits allow an eroding stream to be diverted, ultimately "capturing" all or part of its tributary. This natural process can prove invaluable for highway and business projects by eliminating some expensive construction costs.

departments

18 Explore Missouri **20 DNR News** **22 Top Spots** **25 ... But Not Least**

Above: "Dolly" surveys the Missouri River from a hand-built voyageur-style canoe from Big Muddy Adventures. *Caty Eisterhold photo.*

Front cover: A dog helps his human companion fish for trout at Roaring River State Park. *MoDNR photo by Ben Nickelson.*

Back cover: Tours of Onondaga Cave, at Onondaga Cave State Park, follow a well-lit, paved path and are an excellent way to cool off on a hot summer day. Tours are offered April 14 through Oct. 15 every two hours from 10 a.m. to 4 p.m. *MoDNR photo by Ben Nickelson.*

Paddler's Perspective

A Closer Look at the Big Muddy

by Rob Hunt

In September 2016, people from all over Missouri gathered in the historic river town of Hermann to set up tents and grab a bite to eat in anticipation of a trip. Trains from the nearby Amtrak station rolled by as preparations were made for the following day. These folks were about to embark on a 100-mile journey down the Missouri River by kayak or canoe. This was the first Paddle MO and the riverside park where we camped was buzzing with anticipation.

Holly Neill is the coordinator for Paddle MO, and established partnerships with the Missouri Department of Natural Resources and Earth's Classroom. Neill is the director of Stream Teams United, a nonprofit that supports the state Stream Team program and advances the protection and improvement of Missouri's waterways. The department supports Stream Team by training volunteers to collect water quality samples on Missouri's waterways. The Missouri Stream Team effort has grown to 5,000 teams since its inception in 1989.

In 2015, I joined Neill for Paddle Georgia, an event that spans more than a decade and served as a model for Paddle MO. Little more than a year later, our team stood on the banks of the Missouri River with a group of 62 paddlers ready to hit the water.

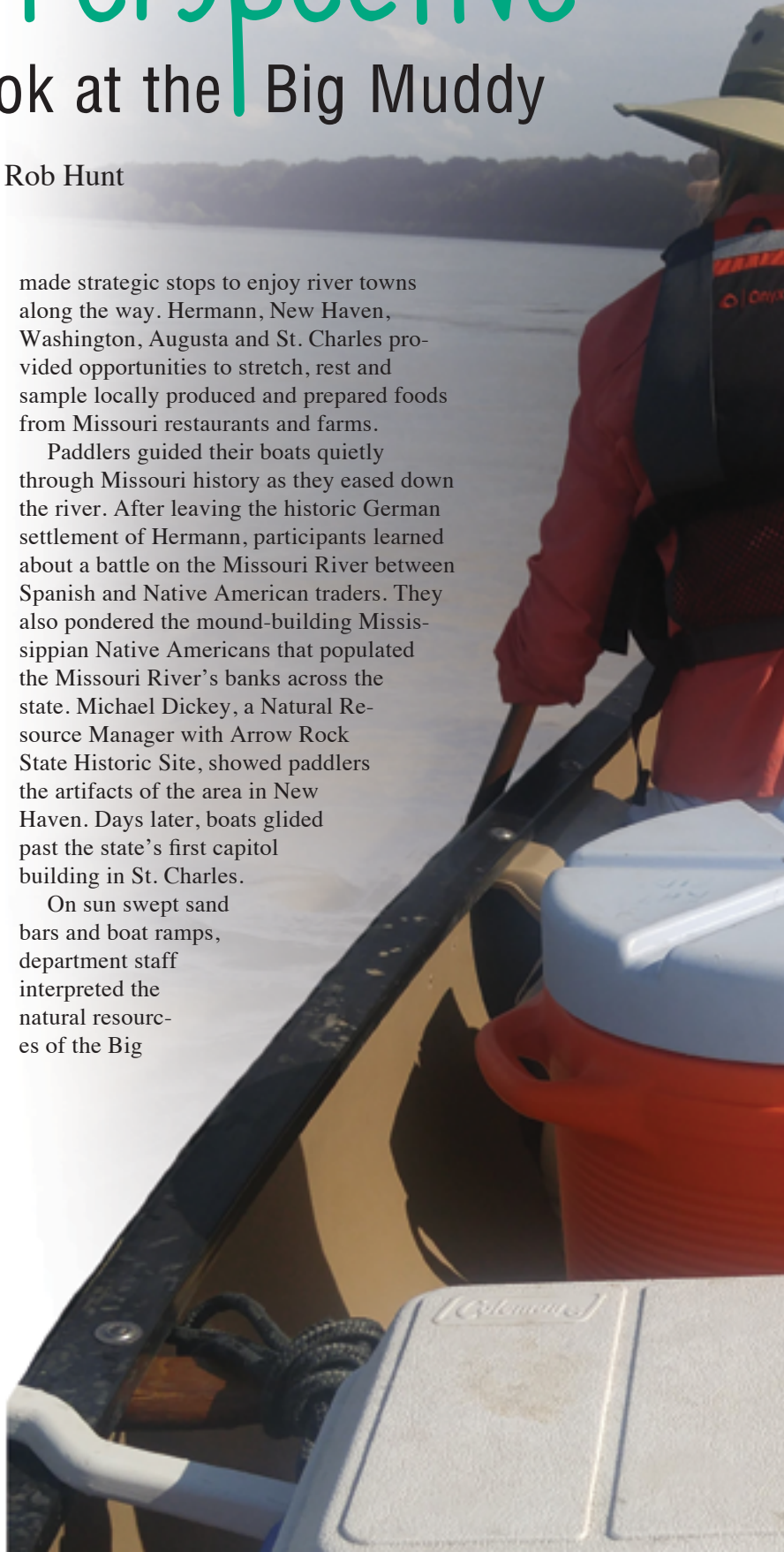
"It is a rare opportunity to spend days immersed in a river experience," said Neill, when asked about the purpose of the event. "To bring a unique adventure to Missourians that encourages connecting to the Missouri River in a holistic way; that was incredibly exciting to me."

The theme of the trip was to connect people to the Missouri River in every aspect: culture, history, agriculture and natural resources. As we paddled down the river, we

made strategic stops to enjoy river towns along the way. Hermann, New Haven, Washington, Augusta and St. Charles provided opportunities to stretch, rest and sample locally produced and prepared foods from Missouri restaurants and farms.

Paddlers guided their boats quietly through Missouri history as they eased down the river. After leaving the historic German settlement of Hermann, participants learned about a battle on the Missouri River between Spanish and Native American traders. They also pondered the mound-building Mississippian Native Americans that populated the Missouri River's banks across the state. Michael Dickey, a Natural Resource Manager with Arrow Rock State Historic Site, showed paddlers the artifacts of the area in New Haven. Days later, boats glided past the state's first capitol building in St. Charles.

On sun swept sand bars and boat ramps, department staff interpreted the natural resources of the Big





Caty Eisterhold photo



Caty Eisterhold photo

(Left) Abbey Hunt rides in the front position of the canoe carrying water and lunches for participants. MoDNR photo by Rob Hunt

(Top) Paddle MO participants pass beneath a bridge on a tributary of the Missouri River.

(Above) Lunch was prepared from fresh, local foods provided by Avant Gardens in New Haven. Pictured left to right: Abbey Hunt, Rob Hunt, Jessica Pearson and Paddle MO organizer Holly Neill.



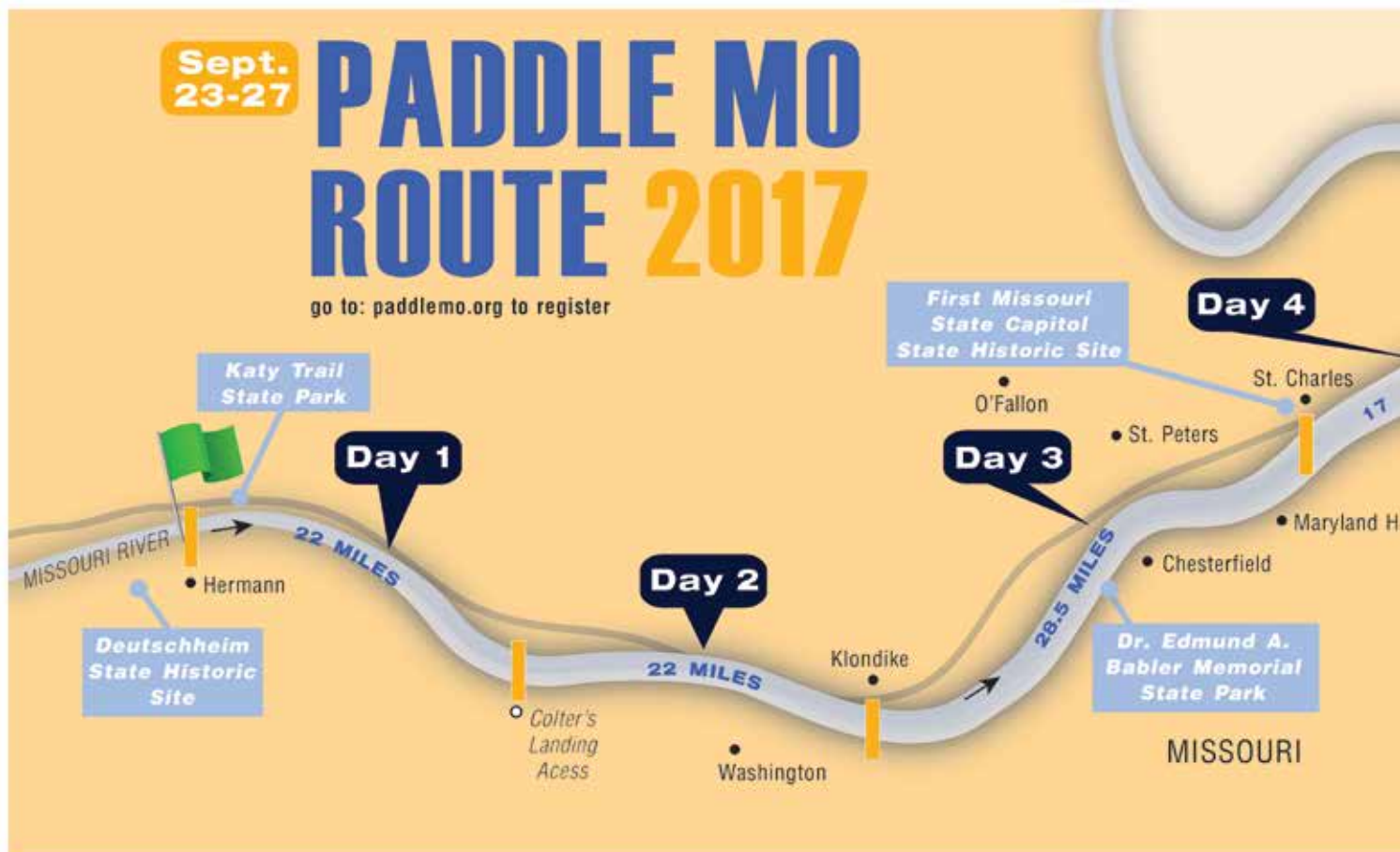
MoDNR photo by Rob Hunt

Aaron and Angie Jungbluth learn about organisms that live along the river, including wild mushrooms.

Muddy with presentations on mussels, fungi and water quality.

“A day on any of our rivers, especially the Missouri or Mississippi, is a great adventure,” said Chris Crabtree, a Missouri State Parks Natural Resource Steward. “It is not often that I am given the opportunity to discuss various aspects of the Missouri River, river ecology or natural history curiosities. This was a fantastic opportunity to present some of this information to a very interested group.”

Paddlers were continually immersed in the beautiful natural resources of the river. Surrounded by swirling water and open skies, our group moved back and forth between shimmering cottonwoods with droning cicadas to humming highway bridges and busy cities. Excursions into river towns bustling with street fairs and barbecues gave way to miles of river solitude as we paddled quietly in a group. We watched monarch butterflies recklessly cross the windy river valley, sometimes at eye level; sometimes mere orange specks above the trees. We were connecting – our natural resources welcomed



A day on any of our rivers, especially the Missouri or Mississippi, is a great adventure.

– Chris Crabtree, Missouri State Parks Natural Resource Steward



MoDNR photo by Rob Hunt

us and we embraced the journey with wide-eyed wonder, very thankful we chose to participate.

Paddlers signed up for as many reasons as there were people on the river. Some were looking for a challenge with the support of a large group of people.

“I was a little concerned about the big river, having only ever paddled on smaller rivers and streams,” said Gail Melgren, director of Tri-State Water Resource Coalition. Melgren was one of many who expressed similar concerns in

Boats line a sandy beach where participants stopped for lunch and enjoyed a presentation about Missouri River ecology. MoDNR photo by Rob Hunt





MoDNR photo by Rob Hunt

After lunch, participants check supplies and prepare to launch for another afternoon of paddling on the Mighty Mo.

the beginning. Others wanted to learn more about this incredible resource that winds through our landscape and history.

“We love the river and enjoy paddling,” said Bill Kloeckner of Lee’s Summit.

“This trip added the allure of getting more acquainted with the towns along the river.”

Others were simply the hardcore Stream Team supporters – people who had miles of stream cleanups under their belts and years of volunteer water quality sampling behind them. The only sampling on this trip was the wide Missouri in its fall splendor. Paddle MO participants came from many walks of life: a retired nurse, a power company employee, a teacher, a sustainable development coordinator, a lawyer and more. Each represented a mosaic of backgrounds and passions. Their paddling experience varied, as well. From hardened racers to beginners, everyone had a place on the trip.

Those who didn’t bring their own kayak or canoe were able to climb aboard a massive wooden voyageur-style canoe called the June Bug. Voyageurs were made popular by French fur traders and can carry more than 12 adults. The builder, Mike Clark of Big Muddy Adventures, expertly steered the June Bug and passengers down the Missouri.

Regardless of why they came, the more important question was what they got out of their time on the river. Kloeckner reflected on the experience when asked if he viewed the river differently now:

“My love and respect has blossomed from familiarity.” This sentiment reflects the purpose of Paddle MO to connect participants to Missouri’s resources in a way never experienced before. “Someone commented that they had driven over one of the bridges hundreds of times but had never seen (the river) from this angle,” Kloeckner added. “This change of perspective provides the opportunity to awaken an interest in issues about use and preservation of the river. Our fellow citizens can-

This trip added the allure of getting more acquainted with the towns along the river. – Bill Kloeckner, Lee’s Summit



MoDNR photo by Rob Hunt

(Above) Brian Wilcox from Meramec State Park spoke to participants about Missouri's important river mussels. **(Bottom)** The 2016 Paddle MO participants gathered for a group photo in Hermann before embarking on their 100-mile journey. Caty Eisterhold photo

not be expected to care about that which they are not aware."

Paddle MO succeeded in many ways. The planning and coordination was seamless; the journey was safe; participants were satisfied and felt empowered from connecting with one of our greatest natural resources in the state and country.

With the lessons learned from the first Paddle MO, Stream Teams United is ready to launch the second Paddle MO for 2017, September 23-27. This trip will span

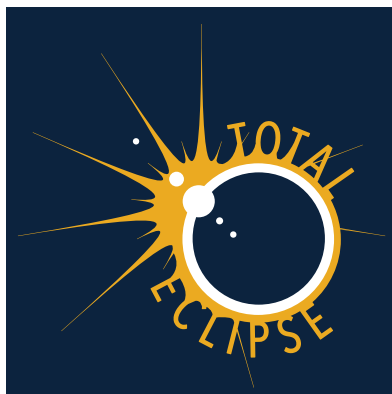
the same 100 miles of Missouri River from Hermann to its confluence with the Mississippi. As the event grows, paddlers can be sure that additional stretches of river currently are being scouted for future trips. To learn more about the first Paddle MO, follow the Special Feature link on the Youth Education and Interpretation page at dnr.mo.gov/education. For more information about the 2017 event and to register, visit PaddleMO.org.

Rob Hunt is the department's natural resource education coordinator.



MAKE PLANS FOR YOUR SPOT IN THE SUN

by Tom Uhlenbrock
photographs by Ben Nickelson



(Top) The only safe way to directly view the full or partially eclipsed sun is through a solar filter, such as these eclipse glasses.

You can purchase a pair at a state park gift shop or by visiting mostateparks.com/shop.

You need a special place to watch this summer's celestial event – a total eclipse of the sun that will send a 70-mile-wide circle of darkness across Missouri.

How about from a lawn chair on a Civil War battlefield? Or the highest point in the state's prettiest park? Or along a scenic stretch of the Katy Trail on a bike ride with some 500 other stargazers?

Missouri is one of 12 states in the direct path of a total eclipse of the sun that will occur at mid-day on Aug. 21, 2017. The last total solar eclipse to cross the state was on Aug. 7, 1869, nearly 150 years ago.

The 1869 eclipse only clipped the northeast corner of the state. This summer's eclipse will begin in the northwest corner of Missouri at St. Joseph and sweep diagonally across the state to Ste. Genevieve.

Those near the center of the path will experience "totality," in which the moon blots

out the sun totally, turning day into night. The blackout will last for over two-and-one half minutes in prime locations.

The state park system has 42 parks and historic sites within the path of totality. Parks in other areas of the state will offer partial views of the eclipse.

Of the 42 state parks and historic sites within the path of totality, 19 offer camping. Reservations require a three-night stay, from Aug. 18 through Aug. 21. To make reservations, visit mostateparks.com or call 877-ICampMO (877-422-6766).

Many parks plan special viewing events. Eclipse viewers and glasses to safely view the eclipse can be purchased at gift shops or at mostateparks.com/shop.

Visit mostateparks.com and click on "Eclipse 2017" to see a list of state parks and historic sites in the path of totality, and the time and duration of the eclipse at each site. Various parks also have eclipse activities listed on their websites under "events."



Total eclipses actually are not rare; two occur somewhere in the world every year. What is special about this one is its path over the United States, with viewing possibilities for millions of people.

This summer's solar outage will occur as a partial eclipse over the entire United States. Totality will last 90 minutes across the country, from Oregon to South Carolina, and about 13 minutes over Missouri.

Missourians can observe the next eclipse in 7 years on April 8, 2024, but the path of totality will cross only the southeast corner of the state.

Temperatures Will Drop

Eugene Vale, an interpretative resource specialist with Missouri State Parks, is passionate about astronomy – and excited about the solar eclipse.

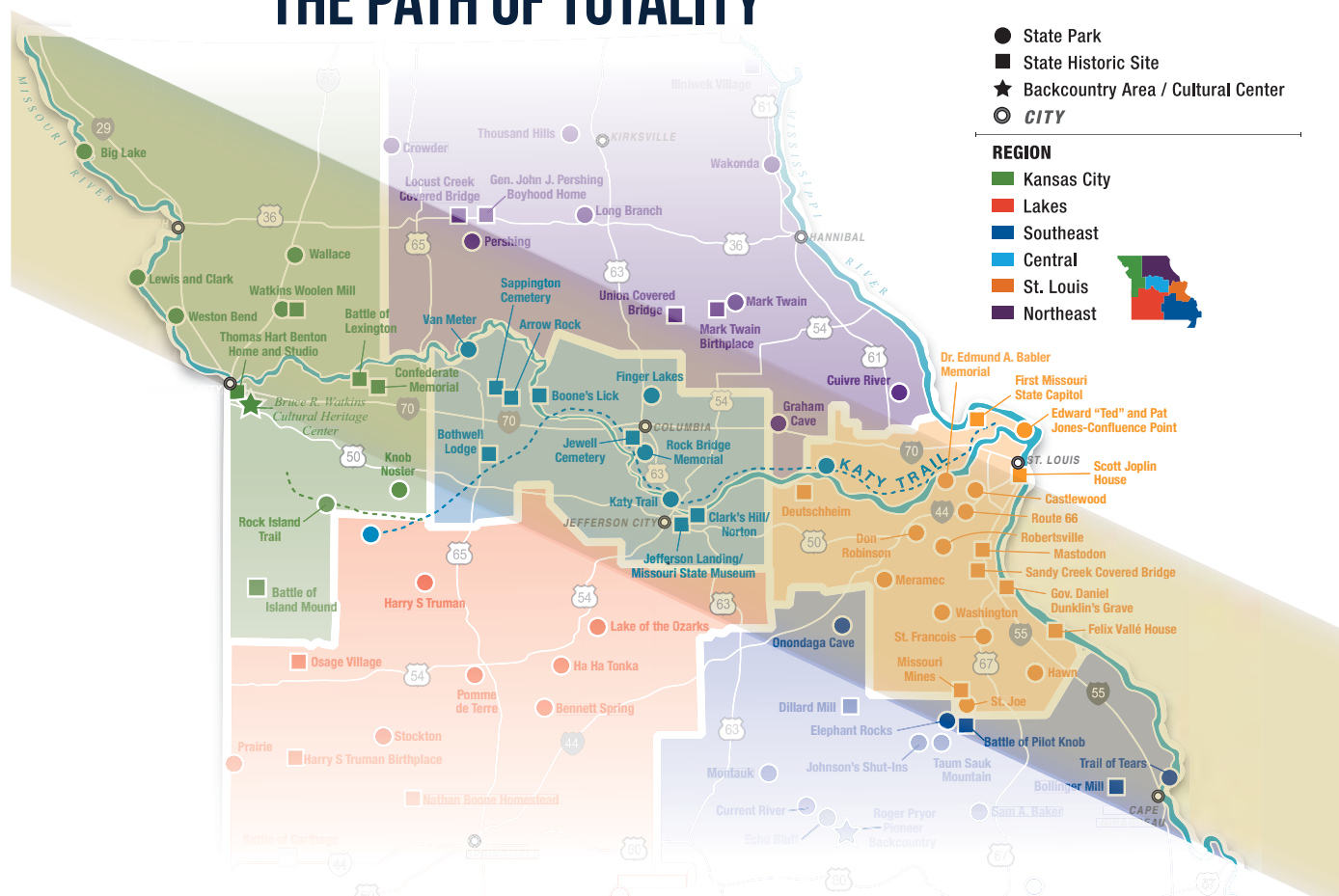
“It will occur about solar noon (1 p.m.), so the sun will be about at its absolute highest in the sky,” Vale said. “No buildings or mountains will get in the way. It will get dark. Temperatures will drop. The brightest stars will be visible.

“When conditions are exactly right, the moon is the same or slightly larger than the



Many state parks in the viewing area are hosting special events, including the Total Eclipse of the Katy Bicycle Ride from Rocheport to Jefferson City. This section of the trail lies within the path of totality and is an excellent spot to view the eclipse.

THE PATH OF TOTALITY



The 42 state parks and historic sites depicted in the yellow band will be in range for viewing the total eclipse.

All other state parks and historic sites will be able to view a partial eclipse.

sun. So when the moon gets directly in between the earth and the sun, it blocks out the solar disc. It happens about twice a year but the diameter of the shadow is only about 60 or 70 miles wide, so only a small number of people get to see it.

“Because this eclipse is over land so long, and not the ocean, it will be one of the longest observed eclipses in history. You really can’t line up boats in the ocean to watch them,” Vale said.

Here are a few of the special events planned at state parks:

Total Eclipse of the Katy Bicycle Ride

A large section of the Katy Trail – from the Greens Bottom Trailhead on the east to the Sedalia Trailhead on the west – is in the path of totality.

Some 500 riders will experience “Darkness during Daylight” in a 36-mile bike ride from Rocheport to Jefferson City.

“The Katy Trail has got a unique position right upon the path of totality; it’s a great

spot to see the eclipse,” said Melanie Smith, trail coordinator.

“We’ll have interpreters along the trail to talk about what’s going on; explaining the process,” Smith said. “We think for a day ride, 500 riders is just about right. They will spread out over the day so we don’t expect it to be too crowded.”

A \$50 registration fee includes an eclipse Katy Trail T-shirt, water bottle, support crew and eclipse glasses. An optional return shuttle for \$25 will haul riders from Jefferson City back to Rocheport.

View From the Capitol Lawn

The Missouri State Museum is hosting a gathering on the south lawn of the Capitol grounds where interpreters will put on displays, including web-streaming of the eclipse as it approaches and leaves the state.

“We’ll be set up most of the morning Monday, until a little after the total eclipse,” said Tiffany Patterson, museum director. “Jefferson City has three days of activities. It’s a street party on Saturday and educational events on Sunday.”

How to Safely View the 2017 Solar Eclipse

Never look at the sun without eye protection, even during a partial eclipse.

If you are in totality (see map on opposite page and at dnr.mo.gov/education/solar-eclipse-map.htm), there will be a very short period (approximately two and one-half minutes) when the moon completely covers the sun. You need no eye protection during this period of totality. You will need protection for the partial phases before and after totality.

Only use approved solar viewing filters for direct viewing. Tested and approved glasses and viewers block harmful and invisible solar rays. Sunglasses do not. You can order approved glasses and viewers from mostateparks.com/shop (below right).

Cover telescopes and binoculars with an approved solar filter. Using an unfiltered telescope or binoculars, even with solar glasses covering your eyes, will magnify sunlight and damage the device, the glasses, and your eyes.

Several indirect viewing methods exist, including making a pinhole camera with a piece of paper, a cereal box, or even your hands (see above right). With your back to the sun, allow the light to shine through a small hole and project an image onto the ground or a piece of paper.

More information about the solar eclipse is available on the Youth Education and Interpretation website: dnr.mo.gov/education/solar-eclipse.htm.



The total eclipse will last two minutes and 40 seconds in the center of the path of totality.



Eugene Vale, Missouri State Parks interpreter, demonstrates a total eclipse to students during the 2017 Earth Day event at the state Capitol.

As far as weather goes, Patterson said, history is in favor of good viewing on a Monday in August.

“The data for the last 100 years show the early afternoon on Aug. 21 is historically clear,” she said. “We’re going with what history says.”

Whispering Eclipse

With sandstone bluffs, a sparkling stream and a mixed pine-and-hardwood forest, Hawn State Park is located in southeast Missouri. Twenty lucky visitors will participate in a guided four-mile hike on Hawn’s Whispering Pine Trail during the eclipse. Call 573-880-8182 to register for the hike. Others can gather near a tent at the park entrance and view the eclipse from an open field.

“We’ll hike up to the highest point in the park; it should be a pretty good place to view it,” said Ed Schott, superintendent at Hawn State Park. “It’s a moderate hike, and it will be hot. At the tent, we’ll offer some shade and cool drinks.”

For those who reserve campsites at Hawn, there will be an eclipse program in the camp-

ground amphitheater on Saturday night and the Riverside Wanderers will perform.

View from the Battlefield

Battle of Lexington State Historic Site has an attractive museum and the stately William Oliver Anderson mansion that tell the story of the “Battle of the Hemp Bales.”

Visitors are invited to bring blankets, chairs and a picnic lunch to watch the eclipse from the battlefield where the Southern-sympathizing Missouri State Guard drove back Union forces.

“There are not a lot of large, open spaces in Lexington, so we’ll be on a nice space on the battlefield, which should have a great view,” said Lindsay Burks, interpretive resource specialist for the historic site.

“This is where the Union had dug their entrenchment, which can still be seen today. It’s mounded up with trenches so large you could put a carriage through them.”

Solar Eclipse Showdown

Washington State Park near De Soto

is known for its petroglyphs and will hold eclipse events at the parking lot within an easy walking distance of the ancient Indian rock carvings.

"From 9 a.m. till noon, we'll have solar energy demonstrations and a one-hour guided tour of the petroglyphs and a nearby glade," said Sharon Hultberg, superintendent at Washington State Park.

"We'll have interpretative displays and kid crafts. We usually have them make a petroglyph necklace, but this time we'll be making eclipse necklaces."

Journey With the Sun

Rock Bridge Memorial State Park near Columbia is offering a five-mile hike for two groups of 40 people into its Gans Creek Wild Area during the eclipse.

There also will be interpreters stationed on four trails that have high areas with prairie restorations that offer open sky views for visitors not on the longer hikes.

"On our four-hour hike, we'll start in the east and travel west, on the sun's route," said Roxie Campbell, park naturalist. "You'll get to experience the park, which has 100-foot bluffs and Gans Creek, which has solid bed-rock and large gravel bars."

Campbell noted that the creek might be a welcome stop in August. "They'll have the opportunity to wade and cool off," she said.

Campbell said she was in the woods for a partial eclipse in 1997.

"It was an odd feeling – the shadows that were cast," she said. "It got like twilight, everything felt a little off kilter."

African-Americans and Astronomy

Because it is a cultural site, Bollinger Mill State Historic Site at Burfordville is adopting a special theme for its eclipse program.

"We're doing a program on African-Americans and their involvement with eclipses and astronomy during different periods of history," said Holly Mitchell, interpretive resource technician.

"Runaway slaves used the Big Dipper and constellations to find their way north," Mitchell said. "Nat Turner's slave rebellion in 1831 was kicked off by a solar eclipse. Nat had a vision that the sun would be blocked out, and he would lead the rebellion."

Another subject will be Benjamin Banneker, a free African-American astronomer, self-educated mathematician and naturalist, who accurately predicted a solar eclipse in

WHY DO WE HAVE AN ECLIPSE, ANYWAY?

First, it's a lucky coincidence for us on Earth. The "apparent" size of the moon in the sky related to the sun during an eclipse is the same. The sun is roughly 400 times bigger than the moon and the moon is 400 times closer to Earth than the sun – this makes the sun and moon appear to be the same size and therefore the moon can "block" out the sun. It's said that we on earth occupy a celestial sweet spot to see this incredible sight.

Viewing the eclipse is a great opportunity to get youth outdoors and get them excited about math, science, technology and just enjoying being outside. No matter where you are in Missouri, you can experience at least 92 percent coverage during the solar eclipse and many will experience much more. This could be a once-in-a-lifetime experience for all of us, so don't miss this opportunity.

The department's Youth Education and Interpretation website provides maps, events, information, web links and multiple videos on the solar eclipse and most importantly – how to view the eclipse safely. dnr.mo.gov/education

- LEARN about the eclipse at dnr.mo.gov/education/solar-eclipse.htm
- PREPARE for the day of the eclipse
- PROTECT your eyes – always!
- ENJOY the experience and being outdoors

the 1700s. "A lot of people thought he was wrong," Mitchell said.

Visitors to the historic site will walk across the Burfordville Covered Bridge to view the eclipse from an open field along the Whitewater River.

For more information on this historic opportunity, visit mostateparks.com.

Tom Uhlenbrock is a former writer for Missouri State Parks, a division of the Missouri Department of Natural Resources.

Stream Piracy

by Jeffrey Crews

photograph by Ben Nickelson

When some Missourians hear the term, “stream piracy,” images of Blackbeard burying treasure and sailing along Missouri streams may come to mind. However, rather than swashbuckling pirates that pillage and plunder, stream piracy is the theft or diversion of water from one stream by another.

“Stream piracies and their abandoned valleys not only are intriguing geologically, they are beneficial economically,” said Carey Bridges, the Department of Natural Resources’ Geological Survey Program director.

“They naturally have been attractive for placing our roads, businesses and industries, and they are excellent locations for farms that put food on the tables of many Missourians.”

Capture and Divert

This hydrological short-circuit can be accomplished as a stream erodes forward until it captures, or diverts the headwaters of a neighboring stream. Stream piracy also may occur by a flanking action where a stream captures part or all of one of its own tributaries.

The result of either process is water from the captured stream flows into the channel of the pirate stream. The flow in the pirate stream grows larger while the captured stream is diminished, leaving behind an abandoned or oversized valley. An example of how stream piracy can shorten the length of a stream and capture the upstream water is presented in Figure 1.

Six Flags – Eureka Stream Piracy

This act of water theft happened at several locations throughout Missouri over the millennia. Two especially interesting examples are located near the city of Eureka in St. Louis County. Millions of people traveling Interstate 44 near St. Louis drive right through a prime example of channel capture called the Six Flags – Eureka stream piracy.

In western St. Louis County, Fox Creek once paralleled the Meramec

Capture and Divert

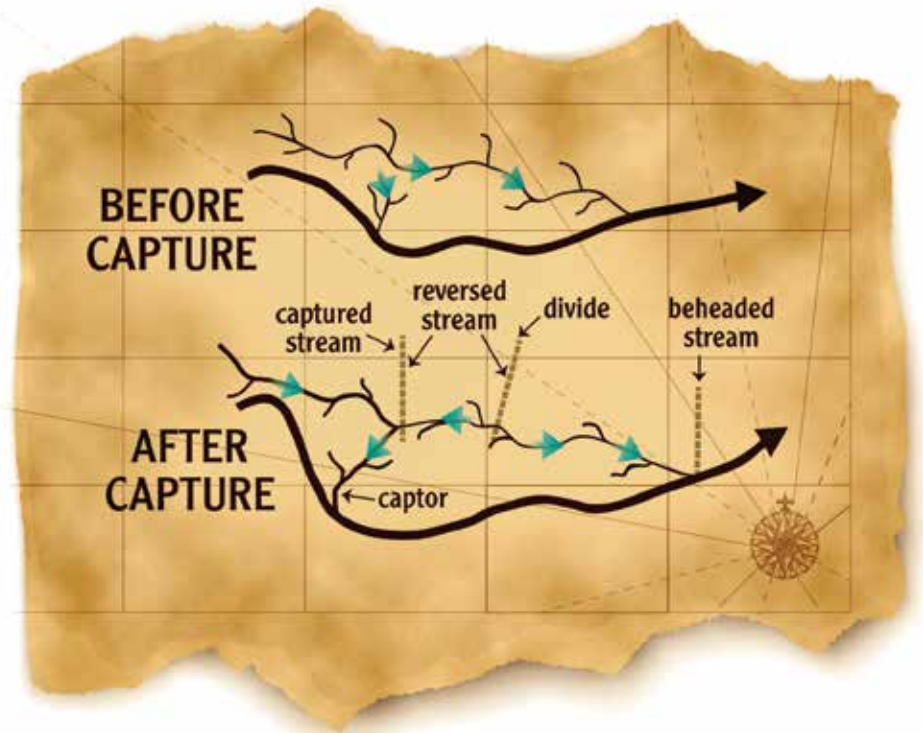


Figure 1. Example of how a stream is pirated and the upper drainage basins are diverted.

River as it flowed east through what now is Eureka. It finally emptied into the Meramec River downstream of Route 66 State Park. The two streams were separated only by a narrow divide. This original stream configuration can be seen in Figure 2.

Eventually, a meander loop of the Meramec River eroded the narrow divide that separated it from Fox Creek near Allenton. The diversion allowed the headwaters of Fox Creek to take a 5-mile shortcut to the Meramec River.

Shortly after that act of piracy, the Meramec River shortened itself by cutting off the very same meander loop that had cut off Fox Creek. Fox Creek not only had abandoned its original stream channel, but also

Stream piracies and their abandoned valleys not only are intriguing geologically, they are beneficial economically. They naturally have been attractive for placing our roads, businesses and industries, and they are excellent locations for farms that put food on the tables of many Missourians.

– Carey Bridges, Director, Department of Natural Resources Geological Survey Program

Six Flags – Eureka Stream Piracy

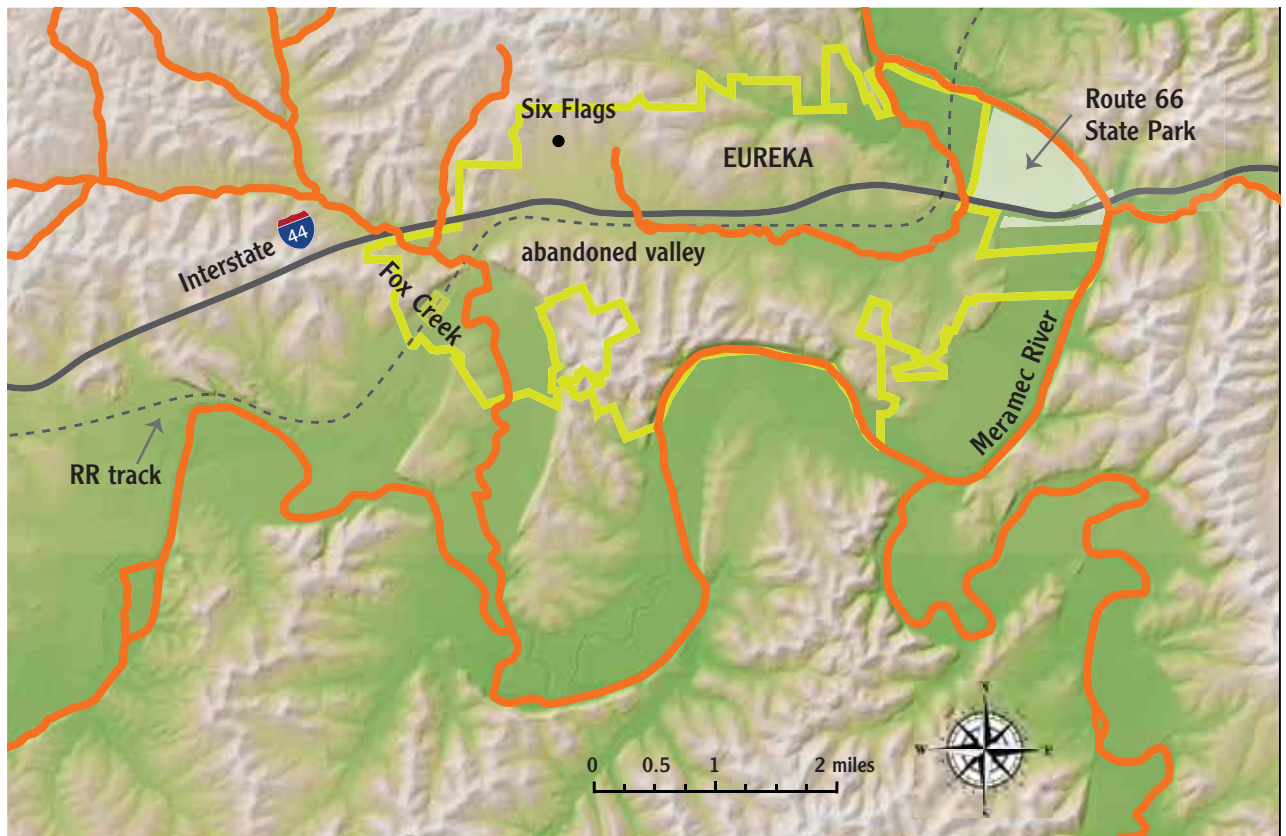


Figure 3. This map shows the current configuration of streams near Eureka. Fox Creek not only is captured from its original channel, it also is flowing through the abandoned meander of the Meramec River.

Ancient Drainage of Fox Creek and the Meramec River

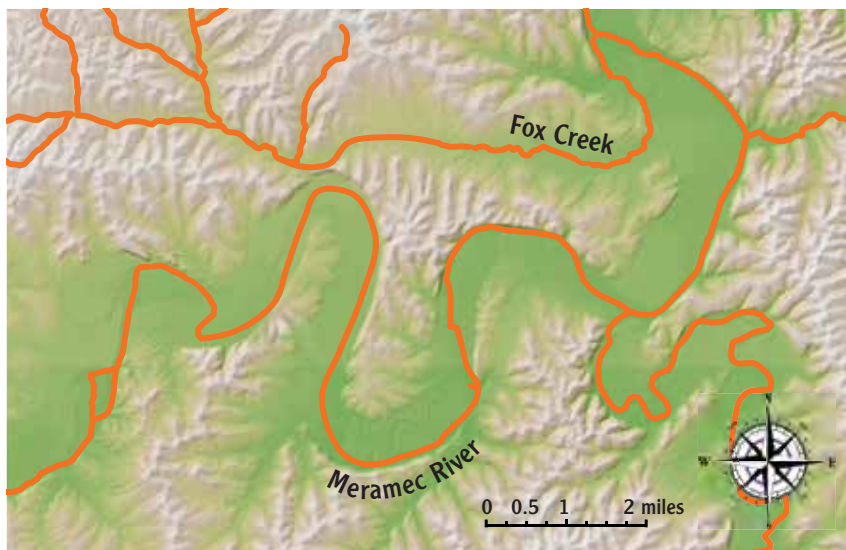


Figure 2. Map showing the channel courses of Fox Creek and the Meramec River before the stream piracy.

now was flowing through the much larger abandoned meander channel of the Meramec River, as shown in Figure 3.

After the piracy of Fox Creek by the Meramec River, the former Fox Creek stream valley from the Six Flags area eastward to Route 66 State Park became a partially abandoned valley, receiving no streamflow at all. The diversion of Fox Creek resulted in a valley ready-made for highway construction. Minimal cut and fill was needed to accommodate the construction of Interstate 44, as well as the outer roads and two sets of railroad tracks.

Moreau River Stream Piracy

A puzzling case of stream piracy occurred along the Missouri River in Cole County near the mouth of the Osage River. Here, an abandoned valley extends westward from Osage City on the banks of the Osage River to the Moreau River, near where it flows into the Missouri River. Halfway up this abandoned valley, a break

Moreau River Stream Piracy

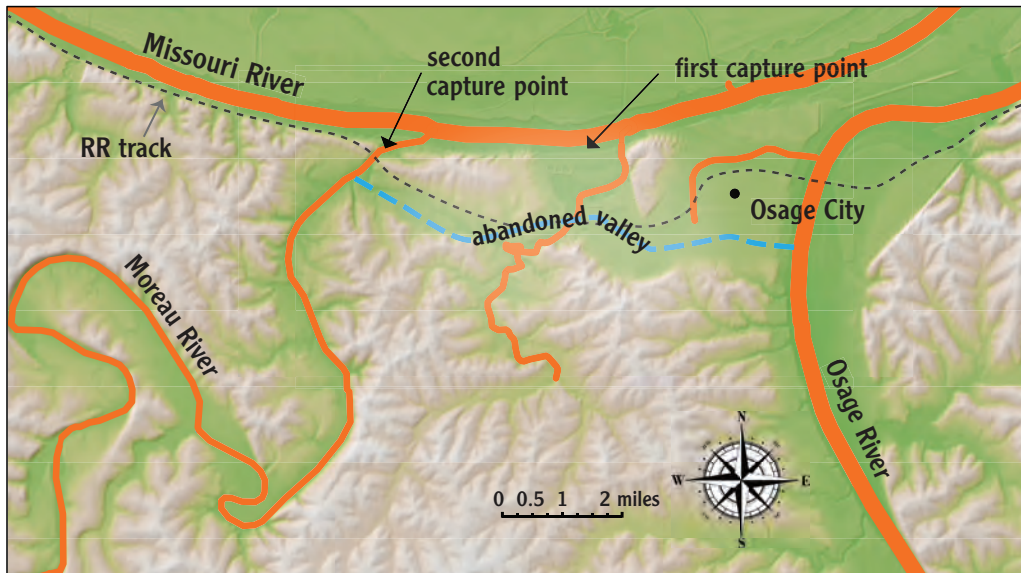


Figure 4. The original channel of the Moreau River and the first and second points of capture by the Missouri River.

(Below left) Cuivre River meanders through a valley of farmland, as seen from an overlook at Cuivre River State Park, near Troy.

MoDNR photo by Ben Nickelson

occurs in the bluff that separates the old Moreau River valley from the Missouri River channel. That break was created when meanders of the Missouri and Moreau rivers likely grew toward each other and eroded away the bluff until the Moreau River eventually broke through and was captured by the Missouri River. This stream capture left behind an abandoned valley stretching to the Osage River, as shown in Figure 4.

The area where the Moreau, Osage and Missouri rivers converge contains well-developed terraces carved by these streams throughout the geologic past.

"The absence of a terrace at the 600-ft. elevation and overall large size of the initial abandoned valley suggest something more interesting also likely happened here," said Larry Pierce, the department's Geologic Resources section chief. "Geologists suspect that the Missouri River once raced through the old Moreau channel from the first point of capture eastward. The swift currents during spring floods or main channel of the Missouri wound through the valley perennially before returning to the main Missouri River flood plain."

These currents likely eroded any existing terraces from the Moreau valley, as well as widened this segment of the abandoned valley and the break in the bluff through which they flowed.



The Moreau River subsequently was captured about 2 miles farther upstream as the narrow ridge separating the two rivers once again was breached, allowing the Moreau River to enter the Missouri River at the Moreau's current mouth. This second capture elongated the abandoned valley, now extending from the present-day Moreau River east to the Osage River. These acts of piracy left behind excellent farmland.

Stream Piracy in Other Regions

Fox Creek and the Moreau River are only two examples of the many occurrences of stream piracy scattered across the state. Missouri is filled with natural wonders, beautiful hills and valleys, and pleasant rivers and clear-running streams.

All are either interesting in their formation, inspiring to behold, or useful for generations of Missourians.

More instances of stream piracy and other geologic phenomena in Missouri can be found in *Geologic Wonders and Curiosities of Missouri*, available for purchase online at missourigeologystore.com or at the Missouri Geological Survey located at 111 Fairgrounds Road in Rolla.

Jeffrey Crews is a geologist with the Missouri Geological Survey, a division of the Missouri Department of Natural Resources.



New Exhibit Explores Missouri's Home Front During WWI

by Steph Deidrick
photographs by Ben Nickelson



On April 2, 1917, President Woodrow Wilson appeared before a joint session of Congress and requested a declaration of war against Germany. Congress voted to grant that request on April 6, 1917. With that action, the U.S. officially entered the Great War, later commonly known as World War I. Exactly 100 years later, the Missouri State Museum in Jefferson City officially opened the exhibit, “Here at Home: Missouri and the Great War.”

Housed in the History Hall of the Missouri State Museum, the exhibit explores Missouri’s home front during WWI. The exhibit highlights the people, industries and efforts to memorialize those who served in the Great War.

“While we’re not equipped to tell the story of the whole war, we decided that Missouri itself had a pretty important story to tell,” said Tiffany Patterson, director of the Missouri State Museum. “To craft that story we looked at Missouri’s considerable and

diverse contributions to the war effort. What did our factories produce? How did our farmers respond to the government call to supply and feed the country’s soldiers? How were women and children impacted by the war? With these questions in mind, we researched what was going on in Missouri from 1914 through the early 1920s.”

While the exhibit does include some famous Missourians who were involved in the war effort, such as Gen. John J. Pershing, the focus is on



(Opposite page) A visitor to the Missouri State Museum views a photo of WWI nurses posed in front of an ambulance train.

(Above left) The museum displays military equipment and munitions produced in domestic factories, as well as other artifacts that show what life was like here at home during the war.

(Above) A sculpture of William J. Stone, who was one of six U.S. Senators to vote against the declaration of war on April 6, 1917, greets visitors to the exhibit.

(Left) Visitors explore the WWI exhibit at the April 6, 2017, grand opening.

(Left below) Missouri's Twelfth U.S. Engineers banner is on display in the exhibit.

the everyday efforts of Missourians.

"We want visitors to the 'Here at Home' exhibit to see that history is made by people just like them," said Patterson. "It will showcase people who are little known, but who made a big impact at the time – at home and abroad."

An example of one of those individuals is featured in a panel in the exhibit on Charles Barger, a Missourian who served in the war. Despite a difficult childhood, he showed courage on the battlefield and became one of Missouri's most decorated soldiers. While he came home to a hero's welcome, he later struggled as he suffered from post-traumatic stress and the long-term impacts of mustard gas.

"In the early 20th century, there were few options for soldiers injured

by war, especially those suffering from illnesses that were not physical," said Patterson. "I think people today, especially Missouri veterans and families of veterans, can see themselves in Barger, and ask some of the difficult questions that come out of war."

During the exhibit's opening ceremony, Barger was posthumously recognized with a Silver Star Service Banner by the Silver Star Families of America. The organization recognizes the sacrifice of those with injuries and illnesses originating in a war zone.

The exhibit itself was nearly a century in the making. One of the earliest efforts to establish a museum in the State Capitol was the Soldiers' and Sailors Memorial Hall, created in 1919. These beginnings provided the museum with a significant collection of World War I related memorabilia,

including regimental flags from Missouri units that fought in the Great War, and service banners from Missouri counties honoring those who served. Many are featured in the exhibit.

The exhibit will be on display into 2018, but one visit does not cover all there is to see. In order to cover more about this important time in history, there are plans to rotate artifacts every six to nine months. Text panels also will be changed to provide different perspectives and highlight additional people, industries and events.

For more on the Missouri State Museum and to learn about specific events that will be hosted throughout the exhibit, visit mostateparks.com.

Steph Deidrick is a former division information officer for Missouri State Parks, a division of the Missouri Department of Natural Resources.

State Park System Celebrates 100th Anniversary



On April 9, 1917, the park system was officially established with the creation of the state park fund. In recognition of this milestone, Missouri

State Parks held two days of celebrations at Bennett Spring State Park and the state Capitol.

On April 9, the Centennial Plaza at Bennett Spring State Park was unveiled. In addition to interpretive panels about the history of the park system, a 100th anniversary time capsule was placed in the plaza. The time capsule includes items from throughout Missouri State Parks and will be opened in 100 years on April 9, 2117.

A ceremony also was held at the Capitol on April 10 in the rotunda. The park system received the official recognition of the Governor, Lieutenant Governor, Missouri House of Representatives and Senate. Centennial sponsors and long-time park users also were recognized.

Through Oct. 31, 2017, visitors can experience all the park system has to offer with the Centennial Passport. Visit mostateparks.com/passport for additional information.

Earth Day Participants Honored



During the 2017 Earth Day celebration, the Missouri Department of Natural Resources honored a student who wrote the winning slogan for the event,

and a woman who works tirelessly on an environmental competition for Missouri high schoolers.

Layla Hayes from Korte Elementary School in Independence took top honors in the statewide Earth Day Slogan Contest. Her entry – “When the sun doesn’t shine, the moon is in line” – describes what will happen on Aug. 21, 2017, when much of Missouri will experience a total solar eclipse. Layla accepted a Governor’s proclamation and a \$50 gift card as well as a rock and mineral set from the department’s Missouri Geological Survey.

Peggy Lemons received the department’s Excellence in Natural Resources Education Award for helping to launch and support the Missouri Envirothon. Begun in 1998, the Envirothon has grown from 10 teams to more than 50, largely because of the efforts of

Time Exposures

Herman Krueger established the Greenwood Cemetery on Jan. 19, 1874, as the first African-American, non-sectarian cemetery in the St. Louis area. In 1890, Krueger sold the property to Adolph Foelsch, who had married Krueger’s daughter Louisa and also was a German immigrant. The young couple operated the cemetery alongside their 13 children, who utilized Clydesdale horses to pull wagons and plows, and transfer caskets to burial plots.

The Foelsch family operated and maintained the property into the late 1970s until it was sold outside of the family in 1981. In 1993, the property was purchased by Solomon Rooks, who was hoping to win a contract to reintern bodies from Washington Park Cemetery when St. Louis Lambert International Airport expanded. When the deal soured, Rooks was financially unable to maintain the grounds, which became severely neglected. In 1999, descendants of the interred along with a group of academic professionals formed the Friends of Greenwood Cemetery, Inc. Their goal was to restore and preserve the site as a historical park and educational resource to celebrate St. Louis’s African-American heritage. In 2002, the Friends of Greenwood Cemetery took over full ownership, and in 2004, the site was added to the National Register of Historic Places. Restoration at the site is ongoing.

This c. 1874 photograph was taken in front of the sexton home that once stood on the property. Several of Adolph’s children are posed with tools of the trade including a wooden coffin, tombstone, flower arrangements, and various digging implements. Sherry McMurphy, a great-great-great-grandchild of Adolph and Louisa Foelsch, provided the photo.



Photo courtesy Sherry McMurphy

Lemons, a program specialist with the Cole County Soil and Water Conservation District.

The department established the award last year to recognize people who connect youth to natural resources. The 2016 recipient was Traci Murray, a teacher at Osage County R-1 School District at Chamois. She and her students volunteered at Earth Day from 2010 to 2016.

More than 1,000 students attended the department's Earth Day celebration. To learn more and to access photos, visit dnr.mo.gov/earthday.

Tuesdays on the Trail to be Hosted in September and October



Seniors are invited to take a tram ride on the Katy Trail

during one of the Tuesdays on the Trail programs. The tours are offered to provide the opportunity to enjoy the trail to visitors who might otherwise not have the ability to do so.

Tours are planned for the first Tuesday of each month in September and October. An interpretive guide will provide a presentation on the history of the Katy Trail, and commentary on the local natural and cultural history along the trail.

The tours are part of Missouri State Parks' Seniors to State Parks initiative with funding for the tram provided by the Missouri Parks Association. For more information or to make a reservation for Tuesdays on the Trail tours, visit on.mo.gov/2nBh6F9.

Avoid Idling When Possible



An easy way to save money and improve air quality is to avoid unnecessary idling.

A vehicle's exhaust contains harmful pollutants, such as carbon monoxide and nitrogen dioxide, and can increase concentrations of ground-level ozone.

WATERSHED SUCCESSES

Man-made Wetland Constructed at Lincoln University

The Environmental Protection Agency's 319 Nonpoint Source and Wetland Program Development grants, through the Missouri Department of Natural Resources, funded construction of a man-made wetland at Lincoln University. The wetland is adjacent to the Moreau River at Lincoln University's George Washington Carver Farm in Jefferson City.



Lincoln University photo

Lincoln University's Carver Farm wetland.

The site was chosen to address erosion issues and demonstrate an alternative use for marginally productive land. Agriculture practices include crop and livestock production alongside research, extension and teaching activities. This project demonstrates the value of wetland restoration in improving water quality, soil conservation, and wildlife habitat. Students use the wetland as an outdoor classroom and laboratory, assisted with planting native wetland plants, and created interpretive trail signs highlighting the wetland ecology.

Groundwater levels and meteorological data are posted online from an observation well monitoring station installed by the department's Water Resources Center. Numerous public tours are conducted annually at Carver Farm. Cooperating agencies include Lincoln University, Missouri Department of Natural Resources, U.S. Department of Agriculture Natural Resources Conservation Service, Ducks Unlimited, Hamilton Native Outpost, Missouri Department of Conservation, U.S. Geological Survey and Three Rivers Electric Cooperative.

Exposure to fumes can impair breathing and cause respiratory problems.

The MoDNR St. Louis Regional Office is collaborating with organizations, municipalities and other agencies to increase awareness. Staff members are spreading the word that frequent restarting does not damage modern starters and batteries. If you're waiting more than 10 seconds in a drive-through line, drop-off zone or parking lot, go ahead and turn off your vehicle.

To learn how schools, municipalities and businesses are saving money and helping the air, go to dnr.mo.gov/pubs/docs/pub2354.pdf.

The brochure also details state laws that restrict idling of heavy-duty diesel

vehicles in the St. Louis and Kansas City areas, both of which have extra regulatory requirements. Those vehicles must limit idling to no more than five minutes in any 60-minute period. Local ordinances may be stricter, for example, St. Louis County limits idling to no more than three minutes for drivers of all vehicles.

For news releases on the web, visit dnr.mo.gov/news.

For a complete listing of the department's upcoming meetings, hearings and events, visit the department's online calendar at dnr.mo.gov/calendar/search.do.

Looking for a job in natural resources? Go to dnr.mo.gov/hr.

Top Spots for Swimming

Nothing beats a cool dip on a hot day, and state parks offer swimming experiences that the entire family can enjoy. Beaches are available at many state parks and make a great destination on a summer day.

Long Branch State Park, nestled in the rolling farmland of northern Missouri, provides plenty of opportunities for water recreation. A sand beach near the campground, complete with volleyball net, provides swimmers access to the lake and fun in the sun.

Another destination for swimmers is Stockton State Park near Dadeville. The clear waters of Stockton Lake beckon visitors to water ski, scuba dive, fish and of course, swim. The park's gravel beach is located at the north end of the park. Also located nearby is a picnic area with tables and outdoor grills.

Although it might be best known for off-road vehicle riding, St. Joe State Park in Park Hills also offers more traditional forms of outdoor recreation. This includes two swimming beaches at Monsanto and Pim lakes. A large shelter with picnic tables is located at Monsanto Lake and is available on a first-come, first-served basis. There also are benches and a volleyball net. Pim Lake and beach is smaller than Monsanto, but has benches, picnic tables and barbecue grills.

The Missouri Department of Natural Resources samples water quality at all designated swimming beaches in the state park system on a weekly basis during the recreational season. The water samples are analyzed and results are posted online at dnr.mo.gov/beaches.

For details about all of the state park system's designated beaches, visit mostateparks.com.



(Top right) A visitor relaxes on a beach at St. Joe State Park as children swim in the distance. MoDNR file photo

(Above right) In addition to boating and fishing opportunities, Stockton State Park offers a secluded gravel swimming beach. MoDNR file photo

(Bottom) Park visitors enjoy swimming and picnicking at Long Branch State Park in Macon County. MoDNR photo by Ben Nickelson



FINGER LAKES STATE PARK WATER TRAIL



Finger Lakes State Park earns its name from the numerous, finger-shaped lakes throughout the park. A former coal-mining operation, the park has nearly a dozen isolated lakes that were left by the mining company and joined together by a series of dams and canals. The park's water trail is located on Peabody Lake and provides a paddler the opportunity to see Finger Lakes State Park from a different angle. The 4.5-mile trail is divided into two sections: the 2.2-mile north section and the 2.3-mile south section. A .4-mile stretch of white connector buoys between the two sections lets you complete the entire trail.

Buoys are placed every tenth of a mile on the path of the trail with blue buoys for the north section and red for the south. Those who want to experience the water trail but don't have their own equipment can rent a kayak or a canoe at the park. Rentals are available March 15-Nov. 15.



Visitors use a canoe to explore the 4.5-mile water trail at Finger Lakes State Park.

(Above) With typically calm waters and equipment available for rent, the water trail is an excellent place to introduce beginners to paddling.

(Below) Competitors race to circle a buoy along the water trail.

MoDNR photos by Ben Nickelson



Focus on Fossils

brachiopods

The outer surface of brachiopod shells can be smooth, ribbed, ridged or spiny. The inner surface is mostly smooth with ridges, muscle scars and other markings that are used in classification and identification.



Brachiopods are a phylum of shelled, marine, invertebrate animals that came into existence during the earliest part of the Paleozoic Era about 520 million years ago and have persisted to present day. Their heyday, with more than 30,000 species, was during the Paleozoic Era that ended 250 million years ago, when a mass extinction wiped out most brachiopods, along with at least 90 percent of all life on Earth. About 400 species of brachiopods are living today. The shell of a brachiopod comprises a pedicle valve (ventral) and a brachial valve (dorsal). The two valves usually are shaped differently.

Both have a pointed beak. The valves are hinged together in their beak regions. The shell is opened and closed in clam-like manner by internal musculature. When a brachiopod shell is positioned with beaks top center, the left half of the shell mirrors the right half, which is a way of saying that brachiopod shells exhibit bilateral symmetry with respect to a plane that cuts perpendicularly through from beaked end to opposite end.

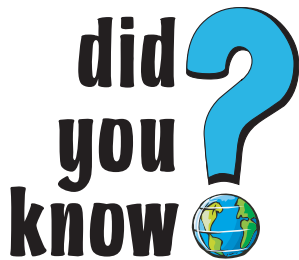
The pedicle valve contains a fleshy stalk (pedicle) that protrudes through an opening in the beak area and serves to anchor the shell to the seafloor.

The brachial valve contains a pair of ciliated appendages called brachia that serve to gather and move suspended food

particles to the mouth. Scientists originally thought in the early 1800s that the brachia function as feet for locomotion; hence, the name brachiopod, which was derived from the Greek words brachio (arm) and pod (foot). One group of brachiopods has tough, somewhat flexible shells made of organophosphatic material. The second group has hard, rigid shells made of calcium carbonate in the form of the mineral calcite. The modern day *Lingula* is an organophosphatic brachiopod. The modern day lamp shell is a calcitic brachiopod. Brachiopod habitat ranges from the intertidal zone down to 600 feet depth. They start life as free-swimming larvae. Then, they anchor themselves permanently to the seafloor and subsist by filter feeding. A brachiopod lifespan is 3 to 30 years.

Predators include snails, starfish, cephalopods, crustaceans and fish. The many kinds of now-extinct, shell-crusher, shark-like, cartilaginous fish that lived during the latter half of the Paleozoic Era would have been major predators.

(Top) This fossil calcitic brachiopod species, Derbyia crassa, is from the 300-million-year-old Upper Pennsylvanian, Kansas City Group, Chanute Shale just north of Grandview, Jackson Co. It measures 1.25 inches from left to right. The outside and inside of the pedicle valve are shown; beak is top center. MoDNR file photos



It Takes at Least 100 Years to Form One Inch of Topsoil

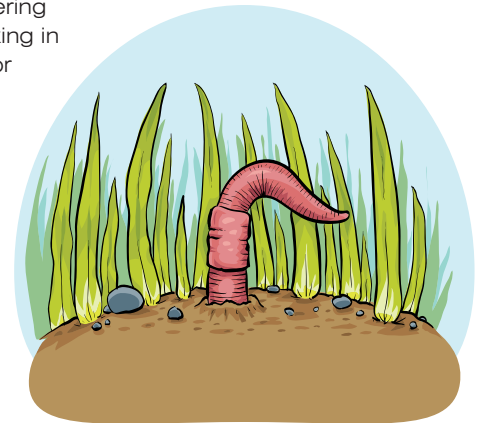
The soil that nourishes our home gardens and farms is more than just dirt. Our soil is complex, and there is more happening beneath our feet than meets the eye. In the

U.S. alone, there are around 70,000 types of soil, and one tablespoon of soil can contain as many organisms as there are people on earth. Soils are arranged in layers, and when we plant we deal mostly with the top two layers – humus and topsoil. As organic matter breaks down and builds the top humus layer, it mixes with rock and mineral particles to comprise the rich topsoil underneath. Seeds germinate and roots grow in the topsoil layer.

A good indicator of soil health is the earthworm. As many as 1.4 million earthworms can be found in an acre of healthy cropland, feasting on other organisms like bacteria that also live in the soil. As much as 15 tons of dry soil can pass through one earthworm each year, and the tiny cracks and

tunnels they create as they burrow help pull organic matter, water and oxygen deeper into the topsoil layer. Some sources put the earthworm's throughput much higher.

Let's keep our topsoil healthy and plentiful by considering cover crops or mixing in some compost. For more information on how to keep your soil healthy, contact your local Soil & Water Conservation District by visiting swcd.mo.gov or by calling MoDNR at 800-361-4827.



... but not least

Helping Communities Thrive

by Hannah Humphrey

Our state's Ozark hills, fertile farmland, rivers and streams represent an enormous natural resource wealth we collectively enjoy. A healthy environment supports a vibrant economy and the Missouri Department of Natural Resources is committed to both. The department's compliance assistance efforts are just one example of how the department helps communities thrive while protecting our most precious natural resources.

The department offers compliance assistance visits to help businesses, communities and industrial facilities better understand the requirements of environmental regulations and stay in compliance with their permits. The department also offers drinking water and wastewater infrastructure planning and compliance assistance to small, rural communities with limited staff and resources.

The city of Koshkonong, in Oregon County, contacted the department after they lost all of their office and utility staff, and their main drinking water well failed. The department's Southeast Regional Office quickly coordinated with the Missouri Rural Water Association, the U.S. Department of Agriculture Rural Development and the neighboring city of Thayer to keep the Koshkonong wastewater treatment system running. An older emergency drinking water well also was brought back online.

Staff spent considerable time assisting the town's mayor.

"Your people in Poplar Bluff are a great bunch, they have come to my town and helped me a great deal," said Koshkonong Mayor George E. Hunt.

By the department helping the city rather than taking regulatory action, its citizens were able to continue drinking safe water and the water quality in a tributary of Bay Creek where the wastewater discharges was protected.

The department is taking assistance to the next level with the launch of the new Gateway for Community As-

sistance portal. The portal provides Missouri communities with customized online access to tools and resources that address their environmental compliance and planning needs.

The system includes services for wastewater, drinking water, stormwater, solid waste, air quality, parks and recreation and more. The web-based system was designed to enable communities to spend less time searching for environmental and financial assistance and focus more time on local economic development efforts in their communities.

Visit dnr.mo.gov/gca/ for more information.

Hannah Humphrey is the Community Assistance Coordinator for the department's Division of Environmental Quality.



Environmental Specialist Tony Kerley visits with George E. Hunt, mayor of Koshkonong, to view a new well and well house that were constructed through an emergency grant.



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Missouri is the Cave State

Explore the underground
with a cave tour and find out
why Missouri is known
as the "Cave State".

From April through October,
tours are offered at Onondaga
Cave and Cathedral Cave at
Onondaga Cave State Park,
Fisher Cave at Meramec State
Park and Ozark Caverns at
Lake of the Ozarks State Park.



*Missouri State Parks – a division of the
Missouri Department of Natural Resources*

